Lesson C1–4

Understanding Moisture Holding Capacity

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 1. Using Basic Soil Science Principles

Lesson 4. Understanding Moisture Holding Capacity

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: **VII:** Apply scientific principles to environmental services.

Benchmark: **VII-B:** Describe soil compositions and properties to demonstrate knowledge of soil science.

Performance Standard: **1.** Describe soil geology. **2.** Describe composition of soil. **3.** Describe the biological properties of soil. **4.** Identify the physical properties of soil. **5.** Describe the chemical properties of soil. **6.** Test soil samples to determine characteristics. **7.** Explain classification of soil water. **8.** Explain the relationship between soil classifications and land use.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain moisture holding capacity.
2. Explain what determines a soil's moisture holding capacity.
3. Determine the moisture holding capacity of a given soil profile.

List of Resources. The following resources may be useful in teaching this lesson:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 10)

Plaster, Edward J. *Soil Science & Management*. Albany, New York: Delmar Publishers, 1997. (Textbook and Lab Manual, Chapter 4)

VAS U4052a, *Understanding Soils.* Urbana, Illinois: Vocational Agriculture Service.

Other Resources. The following resources will be useful to students and teachers:

Illinois Master Gardener. University of Illinois at Urbana-Champaign, Cooperative Extension Service.

Sager, Robert J., et al. *Modern Earth Science.* Austin, Texas: Holt, Rinehart, and Winston, Inc., 1998. (Textbook, Chapter 12)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Copies of Student Lab Sheet
Soil samples
Transparencies from attached masters
Soil pit

Terms. The following terms are presented in this lesson (shown in bold italics):

Available soil moisture
Available water holding capacity
Capillary moisture
Gravitational moisture
Hygroscopic moisture
Moisture holding capacity
Soil moisture tension

Interest Approach. Place a jar of pure sand and a jar of good black soil before the students. Ask them which of the samples would produce the best crops. There may be a variety of answers. Lead discussion in the direction of how much water would be available to plants growing in each of the samples. Which sample will provide the most moisture to the plants? Why? After a consensus is reached, identify specific objectives and possible problems for this lesson.

Summary of Content and Teaching Strategies

Objective 1: Explain moisture holding capacity.

Anticipated Problem: What is moisture holding capacity?

I. ***Moisture holding capacity*** is the ability of the soil within the soil profile to retain water.

A. Moisture is retained in three ways:

A. ***Gravitational moisture*** is the water that moves downward through the soil. It may help replenish groundwater supplies. It is also available to plants.

B. ***Capillary moisture*** is the water that is held within the pore spaces between soil particles. It is also available to plants

C. ***Hygroscopic moisture*** is the soil water that tightly clings to the soil particles. This moisture is usually not available to plants.

B. ***Available soil moisture*** is the water in the soil that can be used by plants. When moisture levels are high, plants can easily extract moisture from the soil. As the water is used, soil moisture tension increases. ***Soil moisture tension*** is the force by which soil particles hold on to moisture.

Use a variety of techniques to help students master this objective. Explain to students that one of the primary contributions soil makes to plants is that it provides moisture. Explain that not all moisture held within the soil is available to plants. Use TM: C1–4A to explain the difference between the types of soil moisture and how soil moisture tension changes with the amount of moisture.

Objective 2: Explain what determines a soil's moisture holding capacity.

Anticipated Problem: What is used to determine how much moisture a soil can hold?

II. Moisture holding capacity is determined primarily by the soil's texture. As a rule, the finer the texture of the soil, the more moisture it will hold. A soil high in sand will hold less water. This results in plants wilting quicker than in loam and clay soils. Soils high in clay, hold water and keep it from percolating out of the root zone. If the soil is entirely clay, it will hold the water too tightly. This means less water is available to plants than if silt were present. A good silt loam holds the most moisture available for plants.

Use a variety of techniques to help students master this objective. Use TM: C1–4B to demonstrate how much water is held by various types of soil texture. Students should be able to relate information to fields in their area. If you have some sandy soil or clay hills in the area, ask students to think about where dry weather symptoms will show up first. Relate this to the type of texture found in these areas.

Objective 3: Determine the moisture holding capacity of a given soil profile.

Anticipated Problem: How do you determine the amount of moisture a soil profile can hold?

III. The amount of moisture the soil can hold for plants is referred to as ***available water holding capacity***.

A. Available water holding capacity depends on:

1. How deep the soil profile is.
2. The type of soil texture found throughout the soil profile. On average, the following textures will hold the designated amount of moisture per inch of soil:

a.	fine textured	.20 inches of water
b.	moderately fine textured	.25 inches of water
c.	medium textured	.30 inches of water
d.	moderately coarse textured	.20 inches of water
e.	coarse textured	.10 inches of water

B. To determine the available water holding capacity for a given area, multiply the depth of each horizon, to a maximum depth of 60 inches, by the amount of water the texture within that horizon can hold. Add the totals for each horizon to calculate total water holding capacity.

Use a variety of techniques to help students master this objective. It is advisable to work through a problem together as a class on a writing surface. Use TM: C1–4C on available soil moisture holding capacity to assist the class in their calculations. When finished, assign LS: C1–4A for further practice in determining moisture holding capacity.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the end of each chapter in the textbooks may also be used in the review/summary.

Application. Application can involve the following student activity using the attached lab sheet:

Determining Available Moisture Holding Capacity—LS: C1–4A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=c, 2=e, 3=b, 4=a, 5=d

Part Two: Completion

1. texture
2. silt
3. increases

Part Three: Short Answer

1. A horizon = 9 × .30 = 2.70 inches
   B horizon = 23 × .25 = 5.75 inches
   C horizon = 28 x .30 = 8.40 inches
   Total = 16.85 inches of water
2. A horizon = 7 × .20 = 1.40 inches
   B horizon = 18 × .30 = 5.40 inches
   C horizon = 35 × .10 = 3.50 inches
   Total = 10.30 inches of water

Sample Test Name: _____

Test

Lesson C1–4: Understanding Moisture Holding Capacity

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. soil moisture tension
b. capillary moisture
c. moisture holding capacity
d. hygroscopic moisture
e. gravitational moisture

_____ 1. The ability of the soil to retain moisture for plants.

_____ 2. The water that is free to move downward through the soil.

_____ 3. The water that is held between soil particles and is available to plants.

_____ 4. The force by which soil particles retain moisture.

_____ 5. The soil water that tightly clings to the soil particles and is not available to plants.

Part Two: Completion

Instructions. Complete the following statements.

1. A soil's _____ is the primary factor in determining how much moisture a soil can hold.
2. A soil high in _____ will hold the most moisture that is available for plants.
3. As the moisture in the soil is used by plants, soil moisture tension (increases or decreases). Circle the correct answer.

Part Three: Short Answer

Instructions. Use the space provided to answer the questions below.

On average, the following textures will hold the designated amount of moisture per inch of soil:

a.	fine textured	.20 inches of water
b.	moderately fine textured	.25 inches of water
c.	medium textured	.30 inches of water
d.	moderately coarse textured	.20 inches of water
e.	coarse textured	.10 inches of water

1. Determine the total available water holding capacity for the following soil profile.

   A horizon = 9 inches deep, medium texture

   B horizon = 23 inches deep, moderately fine texture

   C horizon = 28 inches deep, medium texture

Show your work!

2. Determine the total available water holding capacity for the following soil profile.

   A horizon = 7 inches deep, moderately coarse texture

   B horizon = 18 inches deep, medium texture

   C horizon = 35 inches deep, coarse texture

Show your work!

TM: C1–4A

Types of Soil Moisture

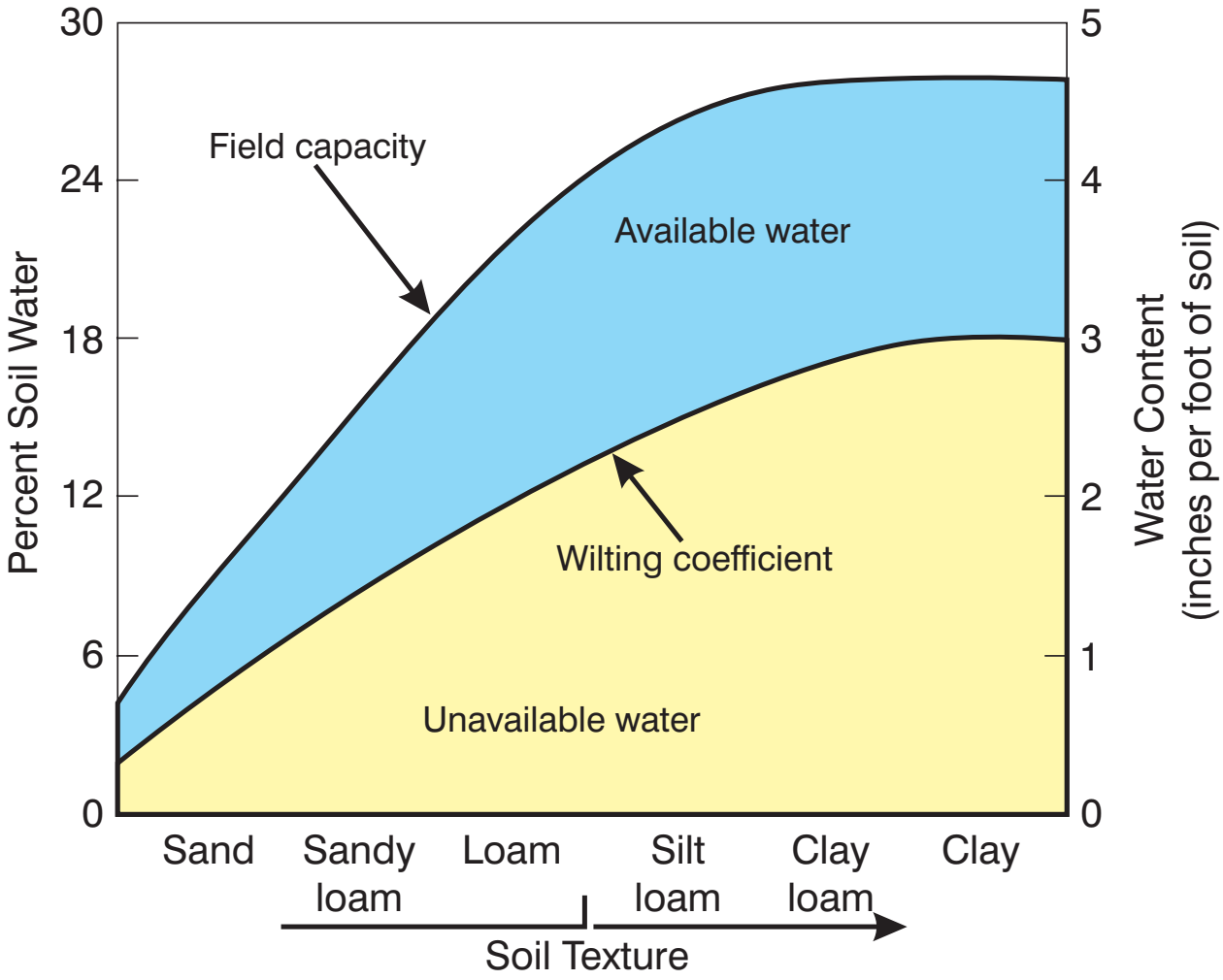
1. Gravitational moisture

2. Capillary moisture

3. Hygroscopic moisture

TM: C1–4B

The Amounts of Available and Unavailable Water Increases as the Clay Content of Soil Increases



TM: C1–4C

Moisture Holding Capacities of Soil Textures

On average, the following textures will hold the designated amount of moisture per inch of soil:

a. **fine textured**
   .20 inches of water

b. **moderately fine textured**
   .25 inches of water

c. **medium textured**
   .30 inches of water

d. **moderately coarse textured**
   .20 inches of water

e. **coarse textured**
   .10 inches of water

LS: C1–4A Name_____

Lab Sheet

Determining Available Moisture Holding Capacity

Purpose:

Determine the available water holding capacity of a soil profile after determining the depths and texture of each horizon within the profile.

Materials:

Calculator
Available moisture holding capacity table
Soil pit
Water bottle for determining texture

Procedure:

1. Determine the depth of each of the horizons in the exposed soil pit. Record your findings. Do not measure beyond a depth of 60 inches.

   a. A horizon depth = inches

   b. B horizon depth = inches

   c. C horizon depth = inches

2. Determine the texture of each of the horizons in the exposed soil pit. Record your findings.

   a. A horizon texture =

   b. B horizon texture =

   c. C horizon texture =

3. Using the available moisture holding capacity table, record the amount of moisture each inch of soil can hold within a particular horizon. Multiply your findings by the depth of that horizon. This will determine the amount of moisture each horizon will hold.

   a. A horizon ____ in. of water/in. of soil × ____in. of soil = ____ Total in. of water held in horizon

   b. B horizon ____ in. of water/in. of soil × ____in. of soil = ____ Total in. of water held in horizon

   c. C horizon ____ in. of water/in. of soil × ____in. of soil = ____ Total in. of water held in horizon

   d. Add the total inches of water held in each of the three horizons to determine total water holding capacity for the soil profile.